

Green Heat

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This paper is one of eight background reports on the Canadian Renewable Energy Alliance's model framework and recommendations for a comprehensive Canadian renewable energy strategy. This paper includes recommendations for provincial energy efficiency and conservation policies and for actions backed up by national enabling measures and international participation.

For information on the recommendations contained in this paper, contact **Bill Eggerston** at the **Canadian Association for Renewable Energies**: eggertson@renewables.ca

The Canadian Renewable Energy Alliance (CanREA) is an alliance of Canadian civil society organizations from the non-profit or voluntary sector that share an interest in maximizing energy efficiency and conservation and promoting a global transition to low-impact renewable energy. Members of CanREA believe that this transition is needed to address global climate change, pollution, global energy supply, human security, poverty eradication and economic sustainability. CanREA recognizes that our window of opportunity is limited and that this global transition must begin now through individual country action, international co-operation and a range of innovative market instruments, regulatory measures, public education efforts and voluntary actions.

The organizations actively involved in the formation of CanREA include:

- Canadian Association for Renewable Energies
- BC Sustainable Energy Association
- The David Suzuki Foundation
- Falls Brook Centre
- The Halifax Initiative
- One Sky—The Canadian Institute for Sustainable Living
- The Ontario Sustainable Energy Association
- The Pembina Institute
- Pollution Probe
- The Saskatchewan Environmental Society
- The Sierra Youth Coalition
- STORM Coalition

For more information on CanREA and its members, visit our website at www.canrea.ca

Green Heat

1. Introduction

Green Heat is the use of a range of proven and market-ready renewable energy technologies that could be used to supply up to 100% of the demand for space heating, space cooling and water heating in Canada's residential and commercial-institutional (C/I) sectors. There are also market opportunities in pre-heating for process applications and for space conditioning in industrial or military sectors, but these are minor. Many Green Heat technologies require a supply of electricity for electro-mechanical operation, but they do not generate electricity nor do they provide motive power; Green Heat provides low-grade thermal energy for low-grade thermal applications and the aggregate technologies are designed to displace the need for combustion heating (using natural gas, oil, coal, propane) or for electric conditioning of space or water.

In Canada, Natural Resources Canada acknowledges four technologies as green heating and green cooling technologies from renewables: geothermal heat pumps, solar thermal water heaters, solar thermal air pre-heaters, and advanced biomass combustors. A number of other technologies (including waste water heat recovery units and air-source heat pumps) could be argued as Green Heat options, and there is significant potential for energy efficiency and conservation to work in tandem with core Green Heat technologies.

In addition to the energy diversification and security of supply provided by Green Heat technologies, as well as their environmental contribution to reduced GHG emissions, the technologies can also displace significant quantities of natural gas that currently is used for these applications.

2. Overview of Canadian picture on issue

Canada has high per-capita consumption of energy for space heating due to our cold winters and sub-optimal thermal efficiency caused by relatively low historic costs for traditional carbon-based heating fuels. Efforts to improve the thermal efficiency of buildings have dropped energy intensity in the residential sector by 8% from 1990 to 2003¹ despite a 23% increase in households and a 29% increase in total floor space, and this has reduced the gross relative demand for thermal compared with electric 'plug load' applications.

The 1.5 billion m² of floor space in 12.2 million homes consume 1,458 PJ of secondary energy while 548 million m² of C/I buildings consume 1,180 PJ. Emissions of GHG (including electricity) are 79.8 Mt and 69.3 Mt, respectively.

The following chart shows the energy consumption (in PJ) and GHG emissions (in Mt) in both the residential and C/I sectors; the potential displacement from Green Heat is shaded.

	res - PJ	res - Mt	C/I - PJ	C/I - Mt
space heating	873	45	644	36
water heating	312	17	76	4
space cooling	18	1	73	5
lights / electrical	255	16	387	25
total	1,458	80	1,180	69
Green Heat potential	83 %	80 %	67 %	64 %

In the residential sector, the 1,203 PJ consumed for applications that could be met by the range of Green Heat technologies, and the resulting 64 Mt of GHG emissions from the use of non-renewable energy sources, represent 83% and 80%, respectively, of total sector consumption and emissions.

In the C/I sector, the 794 PJ and 45 Mt represent 67% and 64%, respectively, of the sector's consumption and emissions that could be eliminated under full penetration of Green Heat technologies.

These calculations show that Green Heat technologies could:

- \$ reduce annual energy consumption by 98,606 MJ and reduce GHG emissions by 5.2 t from each and every residential dwelling unit in Canada (sprawling suburban bungalow to high-rise bachelor apartment);
- \$ reduce annual consumption of energy by 802 MJ and reduce GHG emissions by 0.4 t for every square metre (m²) of residential floorspace;
- \$ reduce annual consumption of energy by 1,449 MJ and reduce GHG emissions by 0.8 t for every m² of C/I floorspace;
- \$ reduce consumption of TPES by almost 2,000 PJ in these two sectors alone, which is equivalent to 60 billion kWh of electricity each year;
- \$ reduce annual emission of CO₂-e by 109 Mt from these two sectors ... more than the 107 Mt released from all coal-fired generating facilities in Canada in 2003.

The basic challenges are to:

- a) increase awareness in Canada of the need to use low-grade thermal energy for low-grade thermal energy applications such as space heating;
- b) quantify and qualify the potential for Green Heat to provide a significant level of secondary energy and a corresponding significant reduction in GHG emissions for space conditioning; and
- c) implement policies to increase the use of Green Heat technologies when feasible.

Green Heat technologies are almost always 'behind the meter' and, as such, are not viewed on the same economic level as green power or green fuel (both of which can be quantified by use of a meter to determine exact consumption). The energy output from Green Heat is rarely valorized; for example, the U.S. Energy Information Administration only guesstimates the contribution from solar collectors, geothermal heat pumps and wood stoves although (in 1998) it estimated that these Green Heat technologies were three-quarters of the TPES capacity of conventional renewable energy sources.

Green Heat industry groups in Canada lack the homogeneity which green power and green fuel groups have developed in recent years, as a result of the positive public profile of wind turbines and ethanol. With the exception of the federal Renewable Energy Deployment Initiative (which is not a subsidy program but an incentive directed by Finance Canada to 'level the playing field'), there is only minor and indirect government or utility support for the range of market-ready technologies.

The industry groups from solar (Canadian Solar Industries Association) and geothermal (Earth Energy Society of Canada) have estimated that, combined, their installations displace the emission of almost 1 Mt of GHG a year. It is more difficult to quantify the net GHG emissions from biomass systems.

A lack of adequate sector training, and the fact that many Green Heat installations are not regulated by professional engineers or similar bodies, has led to concerns over the quality of design and system installation. Also, it is more difficult to assess if systems are performing to specification without monitoring and control devices.

Growing applications for Green Heat include district heating systems, storage (a recent CSA standard governs the design and installation of underground thermal energy storage with earth energy) and hybrid load sharing.

3. Best practices

Tax Credits

The International Energy Agency identifies two countries which provide specific fiscal incentives for Green Heat: Italy (since 2000) allows a tax credit for users connected to a geothermal or biomass district heating grid; and France (until 2012) offers a risk coverage fund dedicated to low-enthalpy geothermal plants with distribution networks.

Directives

The European Renewable Energy Council (April 2005) co-ordinated a declaration from 40 organizations in Europe, calling for a European Union Directive to support heating and cooling from renewables.²

In February 2006, the European Parliament in Brussels adopted a report on Green Heat that calls on the European Commission to present a directive³ for the promotion of Green Heat that will substantially contribute to “securing European energy supplies and to significantly reduce Europe’s dependence on oil and gas in particular.” Half of energy on that continent is consumed for space heating, yet there is no legislation at the continental level to increase the share of renewables in low-grade thermal applications. The report did not call for specific binding targets, but for the share of Green Heat to at least double by 2020.

Green Heat Obligations and Portfolio Standards

The Renewable Power Association, with Friends of the Earth and other groups, is promoting a Renewable Heat Obligation in the UK that would parallel that country’s Renewables Obligation to require a percentage of heating sources be supplied from Green Heat technologies. A UK Royal Commission on Environmental Pollution recently recommended a Renewable Heat Obligation.

A report on geothermal heat pumps, prepared by the industry group Earth Energy Society of Canada, for the David Suzuki Foundation in October 2004, explained that a GreenTherms Standard⁴ in Ontario for new residential construction only, could displace the combustion of 1 billion m³ of natural gas by 2020, to allow the gas to be used in centralized power generation facilities, production of hydro or for export to the United States. There was no value placed on the potential savings for reduced need of transmission upgrade from such an initiative.

Currently, public officials are concerned about the legitimacy of emissions displaced by Green Heat technologies because they are a form of ‘distributed resource’ that is not quantified by electricity meter or similar device. However, a number of jurisdictions around the world have provided ‘deemed savings’ to installations (if you have a working system with x capacity under x parameters, you are displacing x emissions). The use of renewable energy certificates to quantify Green Heat contributions would allow renewable energy and green-house gas emissions trading to be introduced and ensure that the Green Therm Standards or Obligations were met at least cost.

Green Heat Procurement

Governments can show leadership and kick start green industries and distribution networks by setting targets for the purchase of heat from renewable sources in all its buildings.

Local Codes and Standards

Local governments can play a major role in paving the way for Green Heat by including solar readiness and right to light in building codes and bylaws, and ensuring inspectors are properly trained to approve Green Heat installations.

Financing

Green Heat technologies often involve a high first cost. Innovative financing allows the long-term savings from using the technology to pay for the initial cost. Examples include adding the Green Heat cost to a building’s mortgage or leasing cost, or using municipal funds to finance Green Heat technologies and local improvement charges to repay the cost. The latter approach associates the cost of Green Heat with the property and not the owner – making longer-term investments equitable for current owners.

4. Recommendations for Federal Enabling Policies and Support

Constitutional jurisdiction over thermal energy in Canada is ambiguous when the context involves a decentralized, non-valorized format, so the following recommendations to increase the penetration of Green Heat are provided for federal, provincial and municipal consideration, as well as for industry. The federal government could play a major role in transforming heating markets to green technologies by implementing the following:

- 1) Set a Green Heat procurement policy to source 20% of the thermal conditioning load (space heating, space cooling, and water heating) in federal buildings by 2012. This would allow facility managers to select the most appropriate technology for the task (eg: unglazed solar collectors for water heating at national parks) and would recognize that all regions of Canada need to decrease the consumption of fossil fuel sources. In January 1996, the federal government announced plans to purchase 20% of its electricity from emerging green power sources, and it wants at least 35% of gasoline to contain 10% ethanol by 2010. Green power purchases by the federal government were first proposed in the 1994 report to the ministers of finance and the environment by the Task Force on Economic Instruments & Disincentives to Sound Environmental Practices, and the Canadian Wind Energy Association has publicly credit the federal commitment to purchase green power as a key element in that sector's growth.
- 2) Issue a form of 'executive order' to require all federal building managers to undertake an evaluation by 2008 of their thermal energy load, and to identify the true comparative costs of Green Heat options versus conventional heating alternatives which use fossil fuels. The directive should be accompanied by an allowance to use energy service companies (ESCO) and energy performance contractors to install and maintain Green Heat facilities in government buildings. Former U.S. president Bill Clinton signed such an order, to require all federal facilities to examine geothermal heat pumps.
- 3) Implement a campaign to promote 'off-carbon' similar to the off-oil awareness campaign of the post-OPEC crisis. Such a campaign would raise public awareness of the need to decrease consumption of carbon-based energy reserves, and should complement the federal 'made in Canada' campaign to replace the one-tonne challenge.
- 4) Expand the use of class 43.1 under tax law to make Green Heat technologies eligible for accelerated capital cost allowance for all applications in the C/I sector. This amendment should be regulated by 2007.
- 5) Expand emission credit trading concepts by 2008 to include the deemed GHG mitigation impact from Green Heat technologies, and encourage the use of Green Heat options under CDM / JI activities. Support green certificate and other methods of quantifying Green Heat contributions.
- 6) Develop and publicize a clear definition of 'renewable energy' by 2007, that would identify all Green Heat, green power and green fuel technologies. A formal definition would eliminate ambiguity and confusion over the role of biomass, hydro, landfill gas, energy from waste, sequestration and hydrogen as sources of renewable energy.
- 7) Collect and develop accurate and timely data on the existing installed capacity, thermal output and GHG impact of all Green Heat technologies, by 2007, to provide a benchmark and complement these data with near-term and long-term forecasts for all variables.
- 8) Place greater emphasis on lifecycle costing of energy systems, to encourage consumers to understand the combined value of installation AND operating costs for each technology option.
- 9) Develop and maintain CSA standards for all Green Heat technologies.

5. Recommendations for Provincial Strategies

Provincial / territorial governments could support and direct transformation of heating markets by implementing the following:

- 1) Establish Green Heat targets and set a procurement policy for Green Heat, to source 20% of the thermal conditioning load in buildings under their control or ownership by 2012.
- 2) Require regulatory agencies to set GreenTherms Standards which require distributors of thermal heating supplies to source increasing percentages of their energy content from eligible Green Heat technologies, with a target of 20% by 2020. This regulation would be similar to the Renewable Portfolio Standards set in a number of jurisdictions, which require both private and public power utilities to source an increasing percentage of their electricity supplies from green power facilities, and is justified on an equity basis of power and thermal energy suppliers. Develop measurement or deemed contribution protocols and green certificate programs that would allow agencies to meet Green Therm standards at least cost.
- 3) Require all building managers in provincial facilities to undertake an evaluation of thermal energy load by 2008, and use ESCOs and energy performance contractors to install Green Heat facilities in government buildings.
- 4) Enact legislation to allow municipalities to have greater latitude to encourage the use of Green Heat technologies, similar to the planning guidance provided in the UK.
- 5) Include Green Heat readiness and right to light requirements in Provincial building codes starting in 2007. Modify provincial Municipal Legislation as needed to allow the use of local improvement charges to finance Green Heat technologies.

6. Recommendations for Other Actors

While regulatory measures would be required by the two senior levels of government, there are numerous actions that could be undertaken by municipal governments, utilities, corporations and individuals:

- 1) Encourage municipal councils to establish Green Heat procurement policies that would source 20% of the thermal conditioning load in their buildings by 2012, ensure that bylaws do not penalize Green Heat technologies, and provide Green Heat training to all building permit officials and inspectors. Use local improvement charges to finance Green Heat technologies such as solar water heaters and geothermal heat pumps.
- 2) Encourage aboriginal councils and other bodies in remote areas to formulate Green Heat promotional initiatives that would encourage and/or incent the use of non-carbon fuels for space conditioning, and decrease congestion on grid transmission.
- 3) Require municipal building managers to undertake an evaluation of thermal energy load which would identify comparative costs of Green Heat versus conventional alternatives.
- 4) Require municipal covenants by 2012 which will facilitate the adoption of Green Heat technologies at a later date. For instance, buildings should be provided with unfettered southern access to allow solar gain; building lots should be designed for installation of geothermal loops; the infrastructure for district heating and cooling systems should be 'roughed in' on projects.
- 5) Require public and private electric utilities and local distribution companies to provide monetary incentives for the adoption of Green Heat technologies under Demand Side Management programs.

- 6) Require electric utilities to quantify the potential savings which are attributable to technologies which lower grid congestion, through reduced need to upgrade the distribution infrastructure.
- 7) Encourage training institutes to work with industry sectors to develop curricula and delivery mechanisms for various Green Heat technologies.
- 8) Encourage financial institutions to develop and offer 'green mortgages' which reflect the economic and environmental benefits of Green Heat implementation.
- 9) Encourage Canadian Standards Association, Standards Council of Canada and similar groups to update standards on equipment and best practices for design and installation of various Green Heat technologies.

7. Conclusion

Canadians must recognize the potential for a range of market-ready and cost-effective Green Heat options to supply low-grade thermal energy and contribute to environmental goals. Stakeholders must invest in the work needed to transition the market and all levels of government must put policies and programs in place to bring about this transition.

Important near-term venues for making commitments to this goal include meetings of federal - provincial - territorial energy and environment ministers, future federal and provincial budgets, implementation of existing and future Kyoto Plan measures and, above all, any climate change programs by federal, provincial or municipal governments.

Endnotes

¹All data are from the Comprehensive Energy Use Database, 2003, produced by OEE / NRCan, see http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

² See http://www.erec-renewables.org/documents/RES-H/EREC_RES-H.pdf

³ called Renewable Heating & Cooling in Europe

⁴The analysis proposes that 10% of new gas-heated homes and 50% of new electrically-heated homes, be required to install geothermal heat pumps. The concept of a GreenTherms Standard is explained in more detail in the 'Recommendations' section.